Extending the Field of Extended Language: A Literature Review on Figurative Language Processing in Neurodevelopmental Disorders

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Figurative and extended uses of language are nonliteral utterances such as irony, sarcasm, and idioms and comprise a core part of social interaction. Children with typical development (TD) show a progressive adultlike understanding of figurative language around the age of ten. In contrast, individuals with neurodevelopmental disorders such as autism spectrum disorder (ASD), attention deficit and hyperactivity disorder (ADHD), or developmental language disorder often display difficulties with figurative language. However, these difficulties are a puzzle in that the actual underlying causes remain unclear. Those individuals who struggle with understanding figurative language need support through effective interventions. These should be based on solid research findings, which is often problematic as research in this field is characterized by conflicting and incomplete findings. The intention of this study is to conduct a literature review of both available studies and those intervention programs that seek to improve figurative language abilities in these atypical populations. This review will not only provide an overview of available intervention programs but also reveal the research gaps through critically appraising earlier studies. This is done as, in a manner of speaking, research reflects our theoretical understanding of the topic at hand, while interventions reflect the ways in which they are manifested into practice. This will serve to give the reader a more complete overview of the state of knowledge on figurative language and neurodevelopmental disorders. This article may be read for an overview of the field, but it also aims to point out the areas where additional research is needed. For instance, while figurative language takes many forms, there is a disproportionate scholarly focus on metaphors compared to other types. We will ultimately highlight promising approaches and make suggestions for future directions in terms of research and practice.

Keywords: figurative language, comprehension, processing, neurodevelopmental disorders, intervention programs

INTRODUCTION

Figurative language refers to types of verbal utterances that deviate from the literal or conventional meaning of what is being said. Needless to say, this covers a large part of human communication, including language tropes such as metaphors, idioms, clichés, implicature, and hyperbole. There is practically no upper or lower limit as to how long figurative utterances can be, and they also vary

greatly in structure and in degree of transparency. Because of all these factors, figurative language demands more processing than conventional language (Levorato and Cacciari, 2002). Even for typically developing individuals, the skills and capabilities required for this processing take time to acquire, but this is even more so for populations with language deficits. While they remain few in number, some scholars have highlighted the importance of intervention programs, starting with the foundational area of structural language, expressing an intention to build up to the pragmatic level (Kalandadze et al., 2018). The intention of this literature review is to provide an overview of available research and intervention programs; in particular, to highlight those areas that the extant research has given less focus, thus providing suggestions for future directions in terms of research and practice. This goal places the review in a somewhat awkward position. On the one hand, the main value that this article might bring is to reveal the gaps in existing research, but on the other hand, nonexistent research is hard to review. However, by exploring existing works and what they focus on, we may simultaneously highlight what they do not focus on. For instance, the focus in this article is on neurodevelopmental disorders in general, but so much of the existing research is on ASD that this imbalance cannot help but carry over onto the literature available for review. We have avoided some areas, however, where there were no major research deficits that presented themselves to us. For instance, this article will not deal with the literature surrounding metaphors, as these are by far the most studied of figurative language tropes.

The Higher Level of Figurative Language Acquisition

The use of figurative language has captured the zeitgeist of a range of disciplines. It has been a focus of both theoretical and experimental research on typical and atypical language use and comprehension. The study of figurative language is complicated and holistic by nature. Processing figurative communication requires competences beyond the literal, such as cultural knowledge and sensitivity to the context in which the communication takes place. This means that a great many processes have to work in unison in order to decipher figurative language, which may collectively be referred to as communication skills. However, a large part of the literature on figurative language revolves around a central issue, namely, the extent to which such language depends on literal or compositional processes at the initial stages of interpretation (Cacciari and Tabossi, 1988; Gibbs, 1994; Vega-Moreno, 2001; Levorato et al., 2004).

There are many types of figurative language, and thus many factors which may affect the way in which they are processed. The degree to which an utterance relies on context or on external knowledge, its degree of transparency, its length, its linguistic complexity, and its novelty all affect the way in which it is interpreted. Being able to appreciate figurative language requires a combination of cognitive, linguistic, and pragmatic skills (Tolchinsky, 2004; Bernicot et al., 2007). The type of utterance also plays a major role, with regard to the frequency

with which the expression is encountered, the context wherein it occurs, its transparency, and the linguistic skills of the one doing the processing (Nippold and Duthie, 2003). There is general agreement that metalinguistic awareness is a strong predictor in understanding figurative language (Levorato and Cacciari, 2002; Nippold and Duthie, 2003; Nippold, 2006), as is reading comprehension (Levorato, et al., 2004). Accessing the underlying mechanisms with which figurative language is processed has been one of the main research foci within this field (Vulchanova et al., 2015; Benítez-Burraco, 2017). Figurative language is complex and demanding. It requires both perception and processing skills that atypical populations find difficult. Moreover, the difficulties experienced by these populations remain a puzzle, and the actual underlying causes are still unclear.

Figurative Language in Atypical Populations

Everyday social communication skills consist of a combination of literal, figurative, and nonverbal language usages. For typically developing individuals, pragmatic language competences are built up gradually and become seamlessly integrated so that most figurative usages go unnoticed in normal conversation (Vulchanova et al., 2015). However, individuals with neurodevelopmental disorders often have greater difficulties acquiring this naturally integrated grasp of figurative language, which impacts their pragmatic usage.

Isolating the effects of any given neurodevelopmental disorder on language is fraught with difficulties, as many have a range of typical comorbidities that might also impact language skills. Autism spectrum disorders (ASDs) are associated with language impairments and comorbid disorders (Lai et al., 2014; Irvine et al., 2016; Eigsti et al., 2016; Vulchanova et al., 2015) which often, in their turn, impact language development. For instance, approximately 30% of children with ASD also have ADHD (Jang et al., 2013; van et al., 2013; Gillberg et al., 2016; Stevens et al., 2016; Stevens et al., 2016) or other types of neurodevelopmental disorders (Hansen et al., 2018). Unraveling the cause of language delays in any given case is therefore not straightforward.

Figurative language competences in typical development begin to peak somewhere between the ages of nine and eleven (Vulchanova et al., 2012; Vulchanova et al., 2015). Individuals with ASD often seem to experience significant impairments in this area, although the precise mechanism for why this is the case is contested. Some studies have considered that theory of mind (ToM) skills may be necessary to be able to appreciate the complex and nonliteral nature of figurative expressions. This includes idioms, irony, and other forms of language (Happé, 1993; Happé, 1995; Norbury, 2005). In general, there are two main perspectives. The first perspective suggests that the language difficulties observed represent a delay rather than a deficit. Such delays would vary according to the social environment, chronological age, ambiguity of the expressions used, and global language structuring (Melogno et al., 2012a; Melogno et al. 2012b; Vulchanova et al., 2012; Vulchanova et al., 2015).

So far, there is no agreement on how or how much meta-representation skills like ToM, abilities in false belief tasks, and structural language skills (especially grammar comprehension)

are implicated in figurative language abilities. While this remains a controversial point, recent findings have pointed away from a direct link between these variables (Gernsbacher and Pripas-Kapit, 2012; Angeleri and Airenti, 2014; Bosco and Gabbatore, 2017; Kalandadze et al., 2018).

The second approach questions whether there is any direct impairment of figurative language as such, suggesting that this may be a secondary effect of impairments in other aspects of language and cognition (Whyte et al., 2014; Saban-Bezalel and Mashal, 2015). Other proponents of this view place the root cause as issues relating to structural language (Norbury, 2005). However, this explanation seems incomplete as impairments in pragmatic language may also be observed in the higher end of the autism spectrum among individuals with intact structural language abilities (Landa, 2000; Volden et al., 2009; Vulchanova et al., 2012; Vulchanova et al., 2015).

It can be challenging to parse what difficulties stem from the neurodevelopmental disorder itself as opposed to comorbid conditions. For instance, people with such disorders are often also diagnosed with attention deficit hyperactivity disorder (ADHD), which itself is associated with difficulties in figurative language. ADHD is characterized by levels of activity, impulsivity, and aggression above the norm, along with a decreased attention span. These patterns are observable in multiple settings, and thus impact daily social functioning, work, and academic achievement (American Psychiatric Association, 2013). ADHD has also been associated with language delays in 30–40% of cases (Rhode et al., 2019), which may include difficulties in figurative language comprehension (Bishop and Baird, 2001; Bruce et al., 2006; Bignell and Cain, 2007; Donno et al., 2010; Green et al., 2014). The causes for these difficulties are not clearly known, but children with ADHD perform less well than their typically developing peers on almost all language measures (Rohrer-Baumgartner et al., 2016). One plausible explanation for this delay is that it is a secondary effect of the inattentiveness that characterizes ADHD (Somale et al., 2016; Wang et al., 2018), as well as learning difficulties in general (DuPaul and Volpe, 2009) and executive function difficulties (Mattison and Mayes, 2012; Döhla and Heim, 2016).

While ADHD seems to impact several behavioral areas, a developmental disorder that mainly influences reading ability is dyslexia (DYS), and dysgraphia is a common comorbid disorder (Mayes et al., 2018), as well as ASD and ADHD (Henderen et al., 2018). Dyslexia is a specific deficit in the accuracy of reading despite interventions and training, and these difficulties cannot be explained by an anatomical, physiological, or environmental cause (American Psychiatric Association, 2013). Different studies reported poor figurative language performance in individuals with DYS in comparison to their typically developing peers (Cooke, 2001; Griffiths, 2007; Cappelli et al., 2018). Other studies have tried to explain the underlying potential causes of the deficient performance in figurative language–related tasks in individuals with DYS. According to these authors, the interpretation of figurative language strongly relies on good structural language abilities. These observed problems in DYS might be due to difficulties in language competence indeed, for

example, reduced semantic knowledge or vocabulary (Snowling and Hulme, 1994; Stanovich and Siegel, 1994; Troia, 2011; Bishop and Snowling, 2004; Kasirer and Mashal, 2017). Other studies attribute the figurative language impairments to ToM difficulties (Cardillo et al., 2018). Thus, there are many ways in which people with neurodevelopmental disorders may experience figurative language difficulties, and there is an ever present difficulty in separating the effects of the disorder itself and those of any possible comorbid conditions. Such effects may also interact in ways which make separating them meaningless.

Idiom Understanding in Children

As so much of language is figurative, the processing skills needed to comprehend such utterances are an important part of semantic understanding (Nippold, 2006). The skills and competences needed to process figurative language are complex and are only implemented to a degree where children begin to comprehend it toward the later stages in language development. One example of figurative language is the idiom, which is a linguistic trope that makes up a large part of daily conversation (Iakimova et al., 2010; Saban-Bezalel et al., 2019). Such expressions are standard phrases that have a commonly accepted meaning that is different from their literal meaning. Some are more transparent than others. For instance, "he kicked the bucket" is utterly meaningless as a phrase if one is not familiar with it, while "it's raining cats and dogs" would seem bizarre but may be decipherable as its idiomatic meaning has some relation to the literal. They differ from metaphors in that they are predetermined, they are fixed, and often have no internal logic. As such, they need to appear in a recognizable form, making them, in a sense, prepackaged expressions, the constituent parts of which may not be altered for fear of making them unrecognizable (Vulchanova et al., 2015). The ease with which idioms are processed vary according to their conventionality and transparency (Gibbs, 1991; Levorato and Cacciari, 1995; Jackendoff, 2002; Nippold and Taylor, 2002; Lacroix et al., 2010). Learning such processing requires some conventional vocabulary to be in place before nonconventional permutations may be acquired. The heterogeneity of figurative language also means that some are significantly more challenging to master and will require different levels of language development.

There are three main academic viewpoints concerning how idioms are processed, namely, the lexical representation hypothesis, the idiom decomposition hypothesis, and the configuration hypothesis (Saban-Bezalel, et al., 2019). The lexical representation hypothesis holds that idioms are stored as lexical items. Such an approach would entail two parallel operations, these being a more rapidly operating retrieval process and a compositional computational process (Vulchanova et al., 2015; Swinney and Cutler, 1979; Gibbs, 1987; Gibbs, 1991). On the other hand, the decomposition hypothesis states that idioms are processed as complex expressions and that this integration depends on their compositionality (Cacciari and Tabossi, 1988; Gibbs et al., 1989). This means that in order to understand an idiom, the comprehension of the components of the expression is necessary

(Tabossi et al., 2005). Therefore, the main focus from this perspective is on the decomposability of idiomatic expressions, suggesting that they are processed by being broken down into their constituent parts. Alternatively, the configuration hypothesis claims that we access the idiomatic meaning by processing the idiomatic expression word by word until the key main component that will alert us of the expression being an idiom is reached, and consequently, predictability mechanisms will be activated (Cacciari and Tabossi, 1988; Saban-Bezalel et al., 2019). In line with this, a recent study by Cacciari et al. (2018) suggested that it is likely that both the literal and figurative meanings of idioms are partially activated in parallel or sequentially, and what determines one or the other will depend on the type of the idiom (familiarity, predictability, or transparency).

Bernicot et al. (2007) studied the children's ability to distinguish between literal meaning and intended meaning, a capacity known as metapragmatic competence. They investigated three different types of expressions, which were indirect requests, idioms, and conversational implicatures. They found a direct correlation between age and the children's ability to master advanced linguistic tropes such as idioms. In other words, the skills and knowledges needed to decipher nonconventional language are built gradually, starting around the age of five (Levorato and Cacciari, 1995; Nippold, 1998; Nippold, 2006; Kempler et al., 1999; Nippold and Duthie, 2003; Cain et al., 2009; Saban-Bezalel, et al., 2019). A certain level of vocabulary must be in place before figurative language skills may be developed, meaning that this capability is typically formed between the ages of nine and eleven (Vulchanova et al., 2011). The precise way in which this development takes place, however, is an ongoing debate with ambiguous findings. The research of Nippold (1998), Nippold (2006), and Nippold and Duthie (2003) has suggested that this development is linear, similar to lexical development, and that it also continues in adulthood. However, Kempler et al. (1999) have argued that nonfigurative processing develops in nonlinear bursts, much like the way in which vocabulary is acquired, and highlighted the role of exposure and familiarity in this process. Here, the idiomatic competence and the mental lexicon are built up progressively and, in the process, follow the same patterns (Marchman and Bates, 1994; Bates and Goodman, 1997). Moreover, other abilities have been considered necessary to succeed in idiomatic competence. Whyte et al. (2014) investigated the potential predictors for idiom comprehension in both TD children and children with ASD. Their results suggested that structural language in general and syntax in particular are necessary for both the experimental group and the control group in order to ensure a successful idiomatic performance. Furthermore, ToM was found to be linked to idiom comprehension but just for the children with ASD. However, Caillies and Le Sourn-Bissaoui (2008) suggested that ToM is an actual predictor of idiom comprehension in TD children.

There remains a disagreement on how idioms are processed by TD individuals and how these abilities are developed through childhood. For instance, in the field of idiomatic research in general, the degree to which literal meanings are accessed in their processing remains a point of contention, where some disregard

literal meanings entirely (Sperber and Wilson, 2006) and others suggest that the very concept of what counts as a literal meaning needs to be expanded (Ariel, 2002). Regardless of the role played by literal meanings, it is clear that being able to rely on context is central to processing idioms. The presence of the semantic support rendered by such contexts greatly increases the rate of idiom comprehension, as they allow for the meaning to be inferred (Cacciari and Levorato, 1989; Gibbs, 1991; Levorato and Cacciari, 1995; Vega-Moreno, 2001; Laval, 2003; Vulchanova et al., 2015).

The Acquisition of Idioms in Neurodevelopmental Disorders

Much like other forms of nonconventional language, research has showed that individuals with neurodevelopmental disorders have great difficulty in processing and understanding idioms (Kerbel and Grunwell, 1998; Norbury, 2004; Chahboun et al., 2016). Norbury (2004) compared individuals with neurodevelopmental disorders to their typically developed peers with regard to idiomatic performance. Her study utilized two experimental groups, one with specific language impairment (SLI) and one consisting of ASD individuals. The results were that those with SLI and ASD performed below the control group and that idiom comprehension could be predicted by syntax, vocabulary, ToM, and working memory. In addition, this study showed that context acted as a support for all groups in deciphering the idioms, although it did so to a greater degree among the typically developing children.

Baixauli-Fortea et al. (2019) investigated how ToM, working memory, ADHD symptoms, and structural language could predict figurative language and pragmatic skills in individuals with ASD who do not have an ID comorbid condition. Their findings showed that ToM and structural language predicted figurative language abilities in ASD populations. These findings suggest that reinforcing these predictors will eventually positively impact the pragmatic competence.

One of the more prominent perspectives on the figurative language of people with neurodevelopmental disorders was that this could sometimes be explained by them displaying a developmental delay, rather than wholly lacking the capacity. One example of this as regards idioms is a study by Whyte et al. (2014), who compared the syntactic skills of ASD individuals to those of younger children rather than age-matched peers. When this was done, no differences in performance were observed, suggesting a developmental delay rather than a deficit.

The controversy regarding the reason for language deficits among ASD individuals has been mentioned, and it was pointed out that even those with intact structural language perform more poorly in pragmatic comprehension. In fact, even the most highly functioning and verbal ASD individuals generally do not reach the level of their typically developing peers in figurative language comprehension (Micai et al., 2017; Chahboun et al., 2017). One illustration of this can be found in a study conducted by Chahboun et al. (2016), which focused on individuals in the higher end of the autism spectrum. The main purpose of this study was to investigate the effect of the modality in which stimuli

were presented and the presence of supportive context on the comprehension of idioms. Especially in the higher end of the spectrum, structural language is presumably intact; therefore, there is a dissociation between the different linguistic levels, where structural language competence is reported to remain intact in contrast to pragmatic abilities in general and figurative language skills in particular. Another goal of this study was to investigate the effect of age, as two age cohorts of participants were used. This would provide an idea about the development of these individuals through time and experience. The participants performed slower and less accurately than their age-matched peers, supporting the assertion that ASD presents with problems in pragmatic language not resulting from structural issues. Generally, both ASD cohorts were more likely than their age-matched peers to interpret the idioms literally. In addition, the study found that the ASD young adult group (16–22 years old) performed similarly to the child control group aged ten to twelve years, supporting the findings of Whyte et al. (2014). Last, these findings also suggested that ASD individuals processed figurative language using the same strategies, albeit more slowly and less accurately. Comparing the different types of idioms used, it can be observed that the ASD individuals demonstrated the same patterns as the controls, concerning the respective ease and difficulty of the various categories (that vary in transparency and complexity). Broadly then, some research findings fall in line with the hypothesis that the language issues of ASD may represent a delay and that even amongst the highest functioning individuals, this delay is significant.

Several scholars have studied individuals with ASD and compared them to their matched peers in age, structural language, and intelligence, finding differences not only in latencies and accuracy but also in eye gaze and mouse tracking patterns (Chahboun et al., 2016, 2017; Vulchanova and Vulchanov, 2018). Vulchanova et al. (2019) investigated patterns among ASD individuals when processing three different types of idiomatic expressions and novel metaphors. Two cohorts of ASD individuals were compared to age-matched peers in a sentence-matching task. The goal was to explore whether ASD individuals would display divergent eye and mouse tracking behavior compared to the controls, thus suggesting differences in processing, and whether changes in the experimental parameters would have an effect. In addition to the differences in accuracy and speed demonstrated in the study by Chahboun et al. (2016), the participants also deviated in terms of their motion patterns. The ASD individuals showed longer mouse travel times than their peers and a greater number of mouse visits to the target image. Similarly, eye-gaze data showed that the ASD cohorts focused their attention on the images representing the target meaning and the literal meaning, with longer periods of eye-gaze fixation on each. These findings suggest that the ASD participants do not randomly miss the target meaning but in fact consider it as a viable possibility, despite eventually selecting the literal alternative with greater frequency than the control groups. In addition, while TD children outperform ASD children, ASD adults eventually reach a level similar to that of TD children, showing that their language

processing has developed, albeit at a slower rate (Chahboun et al., 2016; Vulchanova et al., 2019). These points further support the hypothesis of a delay rather than an inability. The ASD participants are clearly not confined to a literal view of language, as the fact that the mouse and eye activity does not focus equally on those alternatives not eventually selected, but focuses more on the target meaning, shows that they actively consider a possible figurative interpretation of the stimuli with which they are presented.

One proposed explanation for such findings builds on the fact that as we have argued, standard idiomatic expressions have little internal logical connection to their target meaning, and as such, this meaning must be learned. This being the case, difficulties in deciphering such expressions may be the result of a deficit in semantic language. This would explain both why ASD individuals are able to improve over time, as this provides a greater number of reinforcements, and why they perform better with supportive contexts, which may act as an aid to memory. One study suggesting this view was that of Walenski and Love (2017). This study explored online auditory idiom comprehension among three groups of children, one consisting of ASD individuals, one of individuals with specific language impairment (SLI) affecting morphology and syntax, and one control. The children listened to sentences containing ambiguous idioms with possible figurative and literal interpretations. In particular, the study explores the effects of priming in one direction or the other. The results were that neither the control group nor the SLI group considered the literal meaning, recognizing the idioms as figurative. The ASD group, however, struggled with the task and was primed for the literal rather than the figurative meaning. The authors argued that the SLI individuals, despite their language issues, have intact semantic memories and thus possess the resources to recognize idiomatic expressions as figurative. They explain the greater difficulties of the ASD group than the SLI group by a deficit in semantic memory.

As in other forms of figurative language, individuals with neurodevelopmental disorders display clear difficulties with idioms. A central discussion has been on whether the difficulties displayed are due to a deficit or a delay. Of course, there are many possible neurodevelopmental disorders and possible comorbidities. There are also studies which point in different directions, but the preponderance of the evidence with regard to ASD individuals, one of the most studied groups, suggests a delay rather than a deficit. There seems to be a tendency to view figurative utterances as literal. This can be overcome by the individuals learning the meanings of the idioms, but this takes time, and people on the spectrum may be adults before they develop a "normal" level of idiomatic understanding.

Additional Behavioural Evidence

Melogno et al. (2019) also investigated idiom comprehension but had an ASD group and children with Klinefelter syndrome (KS) in addition to the TD group. KS is a male chromosomal condition with a huge range of variation when it comes to profiles [47,XXY (80%) or 48,XXXY, 48,XXYY, 49,XXXXY, or 46,XX/47,XXY (20%)]. KS and ASD are likely to have similar profiles (Tarani,

2008; Bishop and Scerif, 2011). The condition is known to affect both physical and intellectual development in most of the cases; therefore, the cognitive profile will be characterized by a language delay and an attention deficit and possible learning difficulties. Melogno et al. (2019) used a multiple-choice task to assess idiom comprehension, both with iconic and verbal alternatives. Their findings show similar deficient performances in both clinical populations, ASD and KS.

As mentioned earlier, individuals with ADHD also have trouble when it comes to figurative language. Idioms are no different in this aspect. Crespo et al. (2007) conducted a study with both individuals with ADHD and their typically developing peers who share similar sociodemographic features. The children listened to a conversation taken from a cartoon series. The dialogue included indirect speech acts and idioms. The task was basically choosing between three different options, namely, whether the expression was literal, nonliteral, or just a distracter. The TD children were able to have a higher accuracy rate than the ADHD group. The difference was even more salient in idiomatic expressions. TD children's idiomatic skills increased with age and experience, while those with ADHD remained at the same level (Crespo et al., 2007).

Imaging Evidence and Idiom Understanding in Neurodevelopmental Disorders

Saban-Bezalel et al. (2017) studied lateral hemispheric activation in both individuals with schizophrenia (SZ) and ASD while performing a lexical decision task where the target word could have either a literal or a figurative meaning of an idiom. Their main findings were that SZ patients had right hemisphere activation while the ASD group had bilateral hemispheric lateralization in idiom processing. These results supported the findings of other studies (Gold and Faust, 2010; Colich et al., 2012; Saban-Bezalel and Mashal, 2015) which have also found bilateral hemispheric activation in idiom processing in the ASD group, which is atypical when processing this type of expression. The authors have linked this deviant processing pattern to a problem in executive functions. Another interesting finding within the same study was that their ASD group performed less accurately for literally related targets than for the figurative ones. Here, these findings suggest that the presence of literal targets is distracting, which suppresses the nonliteral implicature and creates difficulties for the ASD individuals, supporting the findings of Gernsbacher and Pripas-Kapit (2012). There are several possible interpretations, but considering that the two clinical groups, SZ and ASD, were matched in age, vocabulary skills, and executive function performance, the simplest explanation is that the individuals with ASD have difficulties in suppressing the figurative meaning in the presence of literally related stimuli, which supports the lexical representation hypothesis explained earlier by Swinney and Cutler (1979).

Another MRI study supporting an atypical brain cortical activation in individuals with ASD while processing idioms is the one by Kim et al. (2018). They conducted a comparative study between ASD and TD individuals. Three conditions were considered in their experiment, namely, neutral (sentences with a dictionary definition and matching pictures), matched (idioms and a congruent image), and mismatched (idioms and mismatched images). As expected, the ASD group performed poorly in comparison to their TD peers. In addition, and as expected, in the mismatched condition, the individuals with ASD showed significantly decreased right inferior frontal gyrus (RIFG) activity and less accuracy in their responses to the idiomatic task. Other research studies have presented strong evidence supporting the premise of the implication of the inferior frontal gyrus (IFG) in pragmatic skills and have considered it a major component of the "mirror neuron" functioning (Kim et al., 2018; Carr et al., 2003; Shamay-Tsoory et al., 2009). The justification behind this is that as human beings, we learn pragmatic skills and we develop them through social communicative situations and imitations, and if the brain area responsible for imitation works differently on a physiological level for the individuals in the ASD group, then it is no surprise that they would perform worse in idiomatic tasks than their typically developing peers. In the matched condition, no significant difference in accuracy was observed. However, the ASD group showed less cortical activity, concretely in the bilateral ventral stream area (VSA), which is responsible for visual reading (Kim et al., 2018; McCandliss et al., 2003; Dehaene et al., 2010; Cohen and Dehaene, 2004; Cohen et al., 2004). The authors explained that this might be due to the atypical and unique neural network in idiomatic processing that ASD individuals have. This agrees with the finding of Vulchanova et al. (2019), who found different processing patterns concerning eye gaze and motor patterns.

Irony Processing Theories

The underlying mechanisms of both oral and written ironic expressions remain controversial. There are six different processing theories: standard pragmatic view (SPV), echoic mention theory (EMT), pretense theory (PT), allusion pretense theory (APT), the echoing-contrasting cognitive operation (ECOP) model, and the parallel constraint-satisfaction (PCS) approach (Ran and Shide, 2020). SPV is directly linked to the cognitive effort needed to comprehend ironic expressions. Supporting this theory, Olkoniemi et al. (2016) found more regressions for written ironic expressions than for nonfigurative expressions. On the other hand, EMT links literal and figurative interpretations and claims that the processing of ironic expressions is rooted in the access to the corresponding literal interpretations as a first step to understanding the ironic meanings, in addition to great working memory skills and the mental lexicon size (Sperber and Wilson, 1986).

Alternatively, PT and APT focus on a completely different dimension. The defenders of PT and APT emphasize the speaker's attitude and intention and highlight the fact that irony will be strongly based on what the speaker feels toward the person the irony is intended for (Clark and Gerrig, 1984). Otherwise, PCS highlights the "habit" variable as a determinant element in irony processing. The more a person is exposed and uses irony in daily life, the stronger the ironic skills she/he would have (Pexman et al., 2000). Also, PCS is a model that considers

intentions, tone, and the speaker's profile as important variables to take into consideration when processing ironic expressions (Pexman, 2008). Here, the listener's processing is based on a neural network composed of all the different relevant clues connected to all the elements of the ironic expression, and the accurate interpretation is achieved when the most "correct solution" is considered.

Last, ECOP bridges the emotional and empathic dimension and executive functions, mainly the working memory (de Mendoza Ibáñez, 2020). This approach relies on the fact that processing irony relies on accessing two situations, the real one and the echoed one that the listener perceives.

Acquisition of Humor, Irony, and Sarcasm in Children

Humor, irony, and sarcasm are common components of interactions in everyday life, allowing us to better cope with daily challenges and to create positive experiences (Martin, 2007; Dowling, 2014; Agius and Levey, 2019). Gibbs (1994) defined verbal irony as a type of figurative language where one highlights the differences between what one expects and what is real or happens in reality (Clark and Gerrig, 1984; Winner, 1988; Kreuz and Glucksberg, 1989; Wilson and Sperber, 1992; Kumon Nakamura et al., 1995; Attardo, 2000). Ironic skills in TD develop from the age of 5–6 years (Dews et al., 1996; Climie and Pexman, 2008; Pexman et al., 2011) and continue improving through middle school age (13–16 years). Filippova and Astington (2008) claimed the existence of a correlation between understanding irony and being able to pass ToM tasks and, more concretely, second-order false belief tasks. This is not surprising since the ability to appreciate the figurative nature of irony demands the ability to infer speech at its intentional and emotional levels (Pexman and Glenwright, 2007).

Pexman and Glenright (2007) studied how children acquire ironic competence. They found that children acquire the ability to understand ironic criticism or sarcasm more easily than ironic compliments but could detect teasing equally well in both complimenting and criticizing. This suggests that the nature of irony will certainly determine if it is acquired. It will continue developing with maturity, ToM skills, exposure to social situations, and leaning.

Angeleri and Airenti (2014) studied the development of joke and irony comprehension in TD children. Their main claim was that despite previous research suggesting that these abilities are acquired by the age of 5–6 years approximately, their findings suggested that this acquisition precedes that and that children who are just 3–4 years old start appreciating jokes and can sometimes understand simple irony. Another central claim was that this irony comprehension competence keeps developing through early childhood while children acquire more vocabulary and ToM competence, supporting other previous studies (Winner and Leekam, 1991; Sullivan et al., 1995; Winner et al., 1998).

Contrarily to the premise that irony is acquired in early childhood (Angeleri and Airenti, 2014), Filippova and Astington (2008) suggested that irony is sufficiently complex that its comprehension is not successful until around nine years of age, when the child's performance in this category becomes similar to that of an adult.

Both Ackerman (1983) and Hancock et al. (2000) claim that irony comprehension relies on two main processes and abilities. The first of these is the ability to appreciate the nonliteral form and its incongruence with the context in which it is presented, while the other is the ability to infer the figurative nature of irony through intonation. These abilities have been directly linked to false belief tasks and ToM, suggesting that these are major predictors of a successful understanding of ironic expressions. In this way, irony comprehension is a more social skill than, for instance, idiom comprehension. They cannot be memorized but must be inferred from largely social cues, such as the state of mind of one's interlocutor.

Atypical Development and Understanding of Humor, Irony, and Sarcasm

As with the other forms of figurative language that have been explored here, humor, irony, and sarcasm have proved difficult for people with neurodevelopmental disorders, although the extent to which this is the case has been contested (Hayashi and Ban, 2020). The majority of studies, such as that of Asperger and Frith (1991), have found that individuals with ASD struggle to both detect and comprehend humor. Contrarily, Ricks and Wing (1975) claimed that this depends on the subtype and that if the humor is simple enough, individuals with ASD would have enough resources to understand its figurative nature. In general, while ASD individuals display difficulties with these figurative forms, their performance will vary depending on their concrete individualities and profiles (Lord and Paul, 1997; Tager-Flusberg et al., 2005).

Silva et al. (2017) conducted a comparative study between children and young adults with ASD and their TD peers regarding their humor processing. Two types of picture sequences were used. The first type was a sequence of two neutral pictures, and the second type was a sequence of two pictures, but in this case, the first was neutral and the second one humorous. Their results suggested that the individuals with ASD and the TD group had a similar performance under the condition that the stimuli did not reflect social situations and cues, supporting the main ASD definition from the DSM 5. This is not surprising considering that the individuals with ASD have impaired social interaction. Another relevant finding was that the performance in the humor-related task also depended on false belief skills and ToM competence.

Wu et al. (2014) sought to go even further in the field of humor and the ASD population and conducted a study where they compared the comprehension of, appreciation for, and preferred styles of humor between individuals with ASD and their TD peers. This was done by using a questionnaire to evaluate the comprehension of and appreciation for nonsense and incongruity-resolution jokes and the Humour Styles Questionnaire (HSQ). Their findings suggested that the individuals with ASD were less likely to recognize the

meanings of nonsense jokes than their TD peers. However, it is highlighted that despite not comprehending these jokes, they found them funny, exhibiting great joy and amusement when reading them. Moreover, the individuals with ASD showed a significant preference for the nonsense jokes where the base was the use of homophones to access the double nature of the expression. This is especially interesting as this might suggest a strategic processing, allowing the higher functioning individuals with ASD to utilize their immense vocabulary skills. They perhaps use their strengths in structural language to overcome the figurative language difficulties. When it comes to affiliative, self-enhancing, and self-defeating humor, the participants with ASD performed worse than their TD peers. However, in the category of aggressive and hostile humor, no differences were observed.

When it comes to irony, Pexman et al. (2011) found no difference between TD individuals and individuals with ASD in terms of accuracy. However, they observed salient differences in processing. This is in line with the findings of Vulchanova et al. (2019). As opposed to this, several other studies reported severe difficulties in irony comprehension in individuals with ASD (Losh and Capps, 2006; Happé, 1993; Adachi, et al., 2004; Kaland et al., 2002; MacKay and Shaw, 2004; Martin and McDonald, 2004; Wang et al., 2006). Potential explanations were impaired ToM (Kaland et al., 2002) or an inability to access a meaning beyond the literal (MacKay and Shaw, 2004). Martin and McDonald (2004) also conducted a study focusing on the higher end of the autism spectrum where structural language is intact. However, unimpaired language ability did not seem to be enough to succeed in understanding irony, and ToM was necessary to be able to pass irony-related cognitive tasks.

ASD has been emphasized because of this and has been the focus of much of the extant literature. However, attention deficit hyperactivity disorder (ADHD) has also been associated with impairment in other types of figurative language as explained previously, and this also seems to be the case for irony (Humphries et al., 1994; Bishop and Baird, 2001; Bignell and Cain, 2007). Caillies et al. (2014) conducted a comparative study between children with ADHD and their TD peers. Both groups were evaluated in ToM (second-order false belief task) and executive functions; in addition, they listened to stories containing ironic expressions and then were asked to answer questions concerning the speakers' intentions, beliefs, and attitudes. Their results suggested that the individuals with ADHD indeed displayed difficulties with the ToM task and irony understanding. This is in line with the findings of Buitelaar et al. (1999), who also claimed that a delay in ToM affects irony comprehension.

Young people with neurodevelopmental disorders typically demonstrate issues with humor, sarcasm, and irony, although this seems more idiosyncratic than some of the other linguistic tropes. ToM has appeared frequently as a potential explanation for figurative language deficits and delays, but it seems more unanimously cited within humor, sarcasm, and irony. This seems reasonable, as understanding these linguistic tropes

demands inferring the fact that the speaker does not mean what he/she is saying literally.

Intervention Programs and Training in Figurative Language Competence
Autism Spectrum Disorder and Attention Deficit and Hyperactivity Disorder

This review provides an overview of previous available data in the field of figurative language in different neurodevelopmental disorders. As noted, a large body of research posits that individuals with neurodevelopmental disorders can neither process nor generate figurative language. This section intends to provide an overview on the available training programs designed to overcome these difficulties. As early as the early 1980s, Robinson and Robinson (1982) claimed that the metapragmatic awareness can improve with exposure and training. Whyte et al. (2014) measured the effectiveness of group training on idiomatic skills in individuals with ASD (some of the children also had a comorbid condition with intellectual disability, ADHD, or Cornelia De Lang syndrome). This intervention was part of a two-week social skills program organized at a community level. At the outset, the children involved displayed low levels of idiom comprehension. Over the course of the intervention, they were able to improve their performance with regard to idiomatic phrases. In a delayed retesting, they demonstrated a greater improvement in the specific idioms practiced during the program, suggesting that the improvement is due to increased memorization. The intervention also demanded testing vocabulary competence, in line with the theories of idiom processing explained above. This suggests that a potential improvement in idiom skills is possible with strengthening structural language abilities and executive functions, particularly memory.

Lundblom and Woods (2012) implemented an idiom-training plan in order to overcome the difficulties that individuals with literacy and language weaknesses might face against the complexity of idiomatic expressions. For this, different sets of idioms were used to study the effects of class-wide peer tutoring (CWPT) intervention on idiom comprehension. Each participant had an intensive reading session of 50 min individually. In addition, the CWPT sessions took place 3 days a week for 5 weeks. Their results suggested that CWPT is indeed an efficient and pleasant way to teach idioms to children. We consider one of the strengths of this training to be the fact that it is conducted in the children's natural environment, which will promote a better focus on the task. In addition, many individuals with neurodevelopmental disorders who struggle with figurative language also have problems with daily communication and social skills. Therefore, this training program would serve to "kill two birds with the same stone". On the one hand, it would increase language skills, and on the other hand, it would potentially improve socio-emotional issues.

Persicke et al. (2013) implemented a training program on sarcasm for children with an ASD diagnosis. Here, the children received training in facial expressions, beliefs, and intentions but not directly sarcasm. The instructions in the first training phase

were basically to automatically process the opposite intention of what the speaker is literally saying. The children were instructed that that was sarcasm. Questions on the situations followed this, and the children received an assessment of their performance and had the chance to actually discuss it. This training phase persisted until the children were able to respond accurately to over 80% of the sarcastic situations, ensuring the success of the training.

Several studies claim that training can improve pragmatic and social abilities in individuals with ASD (Chung, et al., 2007; Tse, et al., 2007; White et al., 2007). Perhaps programs targeting other types of pragmatic and figurative competences would also show positive results (Moody and Laugeson, 2020). Saban-Bezalel and Mashal (2015) also evaluated the effect of intervention in the improvement of irony in individuals with ASD and their TD peers. The results showed that after intensive short-term training, the individuals with ASD improved significantly. In addition, the cortical activation in the right hemisphere of the brain was present in the ASD group, in contrast to a bilateral activation prior to the training. This MRI result showed that the training influenced the cortical activity in the ASD group, making it similar to that in the TD individuals. These results suggest that training does not only influence the participants' results as such but also their abilities on a higher physiological level.

Wu et al. (2016) used a training workshop as an arena to improve humor in individuals with ASD. Young adolescents with an ASD diagnosis and with an intelligence above 70 participated. They were split into an experimental group and a control group and were asked to complete humor questionnaires. After 15 h of training, the experimental group displayed a significantly higher accuracy in the comprehension of nonsense humor. However, incongruent jokes were still difficult to understand. We believe that with even more training, it would be possible to get even better in understanding humorous situations, eventually expanding this to other types of figurative expressions and broader developmental disorders.

Other Neurodevelopmental Disorders

Several studies investigated individuals with learning disabilities (LDs) with regard to their figurative language performance (Kasirer and Mashal, 2017). For instance, both Seidenberg and Bernstein (1986) and Lee and Kamhi (1990) reported that these individuals exhibit poorer performance than their typically developing peers and show salient difficulties in understanding tasks which include nonliteral meanings. On the other hand, another study by Cardillo et al. (2018) reported that the LD group performed better than the DYS one but still significantly worse than their TD peers.

Overall, a general deficit in figurative language performance is observed in different neurodevelopmental disorders. These difficulties vary depending on the diagnostic profile and the individual one. We need to admit in addition that age and severity are components to take into account for any evaluation. Different competences seem to be needed for a successful achievement of figurative language–related tasks. In general, good structural language skills, intact ToM abilities, vocabulary, and good executive functions might be a good ground to focus on for potential training and intervention.

With regard to DYS and learning disabilities, Mashal and Kasirer (2011) conducted a comparative study between these groups and their TD peers where they tested metaphor and idiom comprehension. One of their main findings was that their participants with LD and DYS performed significantly worse in conventional metaphors and idioms but not in novel metaphors. This might be because novel metaphors are usually transparent enough to be processed online or because they were able to use "thinking maps," as the authors call them. We believe that if individuals with DYS and LD are able to process novel figurative expressions without salient problems, it might therefore be possible to use that strength as a starting point for a potential training program.

An MRI study by Saban-Bezalel et al. (2019) investigated the right hemisphere of the neurocortex that has been observed in both individuals with DYS and their TD peers while performing a lexical decision task. Their findings showed a bilateral pattern of hemispheric processing of idiomatic meanings in TD, while the DYS group exhibited a unique right hemisphere advantage. The authors explained these patterns with a potential weakness in the left hemisphere (which is considered the language hemisphere) or perhaps a poorer semantic processing.

A recent study by Đjorđević et al. (2020) investigated the ability of people with intellectual disability (ID) or comorbid conditions (CCs) to understand irony and deception. For this, they used the four subscales of the Assessment Battery for Communication (to assess both the participants' expressive and receptive skills) and false belief tasks to assess ToM skills. In addition, the Raven's progressive matrices were used to evaluate the participants' intelligence, and the Peabody Picture Vocabulary Test was used to assess receptive vocabulary abilities. The results showed that the individuals with ID performed better in general than those with CCs. In addition, the individuals with CCs and ID succeeded in both the production and the comprehension of false statements. When it comes to irony, the group with ID was capable of producing both false statements and ironic statements but failed in understanding them. The same case applied to the individuals with CCs but only for the irony tasks. ToM performance predicted irony and deception comprehension in the individuals with ID but did not predict the performances of participants with CCs. We believe that the comorbid profile of the individuals with CCs makes it difficult to interpret these results, and more research is needed where more details about the participants' profiles are provided.

Lee et al. (2020) investigated whether training could improve children's skills in understanding sarcasm. In this study, the target group was TD individuals who were 5–6 years old, but we believe that this intervention could be beneficial in the case of individuals with neurodevelopmental disorders as well. This training was also a pleasant experience for the participants: puppet shows where the ending scene had either a literal expression or a sarcastic one were used. Afterward, the participants were asked a series of questions regarding beliefs, intentions, and humor that they observed in the shows. The participants were then split into an experimental group and a control group. The experimental group received explicit

instructions about what sarcasm was and how they could realize that the expressions were actually literal, whereas the control group did not. The experimental group performed much better after the training and the explanations, suggesting that it is indeed possible to improve sarcasm understanding in small children and, potentially, individuals with neurodevelopmental disorders. Moreover, if the training was effective with sarcasm, then this could be expanded to include broader types of irony and figurative language.

Most available training programs target TD individuals (Pexman Reggin and Lee, 2019). Nevertheless, we believe that their usage can be expanded to include most neurodevelopmental disorders to a certain extent. Szücs and Babarczy (2017) evaluated the effects of training in irony understanding and found that intensive exposure to irony indeed improves TD individuals in terms of accuracy but also claimed that irony competence is not connected in any way to ToM or structural language abilities but that it is rather social interaction and exposure that improve this area. This is controversial and suggests that more research is needed to determine, on the one hand, the potential predictors of irony in typical development and, on the other, whether this can be stretched to the field of neurodevelopmental disorders.

Limitations and Future Directions

This is a literature review, which aims to provide a general perspective on most of the published studies about figurative language in neurodevelopmental disorders, both with regard to theoretical and empirical evidence and practical research interventions and promising training programs. Perhaps the most salient limitation of this article is the fact that it is not a systematic review; therefore, we have gathered information from a wide range of studies that use different designs and methods, and therefore, many studies are not comparable.

Another limitation that is of concern is the idiosyncrasy of the participants of the various studies, making some of them next to impossible to replicate. The cognitive and linguistic profiles of the participants are usually diverse, and the complex nature of figurative expressions makes the selection of stimuli challenging. We suggest, in consequence, more homogenous groups. We acknowledge the difficulty of this mainly because

of the high levels of comorbidity within neurodevelopmental disorders. We also recommend a careful selection of stimuli and improved experimental designs. These would reveal potential gaps, aiding us to better design intervention programs adapted to the needs of the target populations.

Last and not least, this article has focused on a number of different neurodevelopmental disorders, some of which are far better covered in the literature than others. We therefore would like to highlight the vital importance of expanding the research to include other disorders with different language profiles.

CONCLUSION

In conclusion, individuals with neurodevelopmental disorders show a poorer performance in figurative language skills. Different studies have attributed the performance insufficiency to different causes like ToM skills, problems in general, structural language, poor vocabulary, or semantic deficits. Others, on the other hand, believe that the low performance in figurative language is due to an atypical processing of these expressions, for instance, deviant eye gaze and motoric patterns, or atypical cortical activation (especially in the right hemisphere).

Several other studies have claimed that individuals with neurodevelopmental disorders have a delay rather than an inability and that it is possible to improve with good and intensive training. In line with the findings of Kalandadze et al. (2018), we strongly recommend training both individually and in groups, interventions on both an educational and a social level aiming to improve the general functioning of these populations.

AUTHOR CONTRIBUTIONS

SC has written the main text and carried out the bulk of the literature review. ØK has carried out supplementary literature review and written sections related to it. AP has supplemented the literature review, rewritten large portions of the text, and proofread the manuscript.

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